UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/015,224	12/13/2001	Jun Sawada	AUS920010610US1	6318

7590 11/16/2005	EXAMINER
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	ART UNIT	PAPER NUMBER
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Dallas, TX 75380		

DATE MAILED: 11/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	10/015,224	SAWADA, JUN
	Examiner	Art Unit	
	David Silver	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

    4a) Of the above claim(s) *5,18 and 31* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-17 and 19-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

        1.☐ Certified copies of the priority documents have been received.

        2.☐ Certified copies of the priority documents have been received in Application No. _____.

        3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
    Paper No(s)/Mail Date _____.

4)☒ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. *110305* .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1. Claims 1-31 are pending in Instant Application. Claims 5, 18 and 31 were cancelled in a response filed 10/24/05.

2. Claims 1-4 and 6-17 and 19-30 have been resubmitted for reconsideration to the Examiner.

Response to Objection of Claim

3. The Examiner thanks the Applicant for correcting the objection to claim 27. The objection to claim 27 has been withdrawn.

Response to 35 USC 101 Rejections

4. The Examiner thanks the Applicant for correcting the issues that were rejected under 35 USC 101. The rejection of claims 1-13 and 14-26 have been withdrawn.

Response to Arguments

5. Applicant's arguments filed 10/24/05 have been fully considered but they are not persuasive.

6. Regarding claims 1-4 and 6-17 and 19-30, the Applicant argues primarily that the amendments to the claim overcome the rejection. The Examiner respectfully disagrees and traverses the amendments.

7. **Regarding claim 1, 14 and 27:**

Applicant argues primarily that:

> While the reference [Groote] makes a vague 'envisage' comment regarding incorporating function symbols into EQ-BDDs, there is no indication of how this might be done and more importantly there is no indication that such inclusion of function symbols into EQ-BDDs would result in any ability to establish an ordering relationship <u>such that both functions terms and variables can be compared with one another</u>. Nor does the cited Kondo reference teach or suggest this newly added step of claim 1. The reference merely describes an ability to partially order function symbols in an unrelated context, but does not teach or otherwise suggest any ability to compare function symbols and variables.

The Examiner agrees with Applicant's assessment that Groote indeed provides motivation to combine (envisage).

The Examiner traverses the argument relating to "the reference merely describes an ability to partially order function symbols in an **unrelated context**, but does not teach or otherwise suggest any **ability to compare function symbols and variables**". Specifically, it is quite clear that Kondo's disclosure is related to the Applicant's validation claimed invention. Specifically, the Examiner draws the Applicant's attention to Kondo's abstract with emphasis on "verification procedure" in the below recited paragraph.

The Examiner however respectfully disagrees with Applicant's arguments regarding the amended subject matter. Specifically, Applicants argue that references provided do not teach the newly a added limitation:

> "establishing an ordering relationship of the binary decision diagram that allows the function symbols and variables to be compared"

The Examiner respectfully traverses the arguments. Specifically, Groote discloses establishing an ordering relationship of BDDs. Groote does not substantially disclose such the ability to compare function symbols and variables. Groote however indicates motivation to combine the said feature into his design. The Examiner draws the Applicant's attention to the abstract of Kondo (emphasis added), which discloses and teaches the said limitation:

> We present a method of proving the termination of term rewriting systems (computational systems specified by a set of rewrite rules) by using binary decision diagrams (BDD's) for efficient representation of provability. First, we give a recursive definition of the Boolean function that computes the provability based on a **partial ordering > on the set of function symbols**. Then the construction of the BDD's for this function, in which a primitive expression **f>g** consisting of two **function symbols f and g is associated with the logical variable** x/sub fg/ is incorporated into an interactive, incremental termination **verification procedure**. We conduct some experiments to see how the performance of this procedure is affected by some heuristic selection of variable orderings and constraint orderings, and show that our method and heuristics are useful.

Applicant's arguments are fully considered but found unpersuasive. The Examiner therefore maintains the 35 USC 103 rejection for claim 1 and its functional equivalents: claims 14 and 27.

8. **Regarding claims 2-4 and 6-13:**

Applicant's arguments are fully considered but found unpersuasive. Specifically, the arguments

are strictly based on the virtue of their dependency. The parent claim is rejected. The Examiner

maintains all rejections regarding the Instant claims as details in Office Action dated 7/22/05.

9. **Regarding claim 2:**

Applicants primary argue that:

> Further with respect to Claim 2, Applicants have amended such claim to include
> features of original Claim 5 [...]. [...] None of the cited reference teach/suggest
> this claimed two-pronged ordering technique or its resulting advantage.

The Examiner respectfully traverses Applicant's arguments. Specifically, Applicant fails to

traverse the rejection of the original claim 5. Because claim 5 was rejected under 35 USC 103

the Examiner maintains the rejection of claim 2 by incorporating the rejection of claim 5 into

claim 2.

Applicant's arguments are fully considered but found unpersuasive. The Examiner therefore

maintains the rejection of claim 2 and its functional equivalents: claims 15 and 28.

10. **Regarding claims 14-17 and 19-30:**

Applicant's arguments are fully considered but found unpersuasive. Specifically, the arguments

are strictly based on the virtue of their dependency. The parent claim is rejected. The Examiner

maintains all rejections regarding the Instant claims as details in Office Action dated 7/22/05.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness

rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or
> described as set forth in section 102 of this title, if the differences between the subject matter
> sought to be patented and the prior art are such that the subject matter as a whole would
> have been obvious at the time the invention was made to a person having ordinary skill in the
> art to which said subject matter pertains. Patentability shall not be negatived by the manner
> in which the invention was made.

11. Claims 1-4, 6-17, 19-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Equational Binary Decision Diagrams" by J. F. Groote and Jaco van de Pol ("Groote" hereinafter), and further in view of Kondo H. and Kurihara M. ("Kondo" herein after).

12. As per claim 1, Groote substantially discloses the claimed invention. Specifically Groote teaches a method for validating hardware through the use of a binary decision diagram **(pg.: 1 section 1 lines: 1-4)** having features: applying one more of a plurality of transformation rules to simplify the BDD **(pg.: 9, line: 3rd from bottom)** wherein the set of rules are disclosed on **(page 9, definition 22)**. Further, Groote discloses repeating the transformation rules to the BDD until no more of the transformation rules may be applied and determining, when no more of transformation rules can be applied **(pg.5 section 2.2, lines 2-3)**, whether the BDD has been reduced to a single true value **(pg.1 section 1 lines 5-7, "tautology")**. Groote does not specifically detail the inclusion of function symbols and the ability to compare function symbols and variables. Kondo however discloses an analogous system wherein the said features **(Kondo's abstract)**. It would have been obvious to one of ordinary skill in the art at the time of the Applicant's to combine the teachings of the cited references. Specifically, Groote provides motivation on **page 3, paragraph 2, lines 5-6** by stating that they envisage that such inclusion can be accomplish straightforwardly. Furhter Groote provides reasoning for such inclusion as "the fact that equality is incorporated directly, instead of encoded, can give BDD-techniques a much more prominent place in interactive theorem provers like PVS." **(page 3 para 2)**

13. As per claim 2, Groote substantially discloses the claimed invention, comprising defining a first ordering relation on a set of terms, including variables **(pg.4, definition 5, line 1)**. Additionally, Groote also discloses defining a second ordering relation on a set of equalities, wherein the set of equalities includes equalities between the terms ordered by the first ordering relation **(page 4, definition 5, line 4)**. Although Groote discloses the inclusion of variables in the BDD, the reference does not specifically detail that the ordering relation will

be applied to function symbols. However, Kondo discloses an analogous system wherein the function symbols are also included in the ordering relation on the terms **(Kondo's abstract)**. It would have been obvious to one of ordinary skill in the art of hardware validation with the use of BDDs, at the time of the present invention, to combine the teachings of the cited reference. In fact, Groote mentions such motivation on **page 3, paragraph 2, lines 5-6** by stating that they envisage that such inclusion can be accomplish straightforwardly.

14. As per claim 3, Groote discloses a method of claim 2, wherein the first ordering relation follows a subterm property (page 4, definition 5, line 1).

15. As per claim 4, Groote discloses a method of claim 2, wherein the first ordering relation follows a monotonicity property (page 5, definition 8, lemma 9: Proof).

16. As per claim 6, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s=s,H,K) into a node of the form H (page 5, definition 6, item 6).

17. As per claim 7, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s=t,H,K) into a node of the form ite(t=s,H,K) in response to a determination that t is greater than s in an ordering relation having a subterm property and a monotonicity property (page 5, definition 6, item 7).

18. As per claim 8, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s=t,H,H) into a node of the form H (page 4, definition 6, item 1).

19. As per claim 9, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s=t,ite(s=t,H,K),L) into a node of the form ite(s=t,H,L) (page 4, definition 6, item 2).

20. As per claim 10, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s=t,H,ite(s=t,K,L)) into a node of the form ite(s=t,H,L) (page 4, definition 6, item 3).

21. As per claim 11, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s.sub.1=t.sub.1,ite(s.sub.2= t.sub- .2,H,K),L) into a node of the form ite(s.sub.2=t.sub.2, ite(s.sub.1=t.sub.1- ,H,L),ite(s.sub.1=t.sub.1,K,L)) in response to a determination that s.sub.1=t.sub.1 is greater than s.sub.2 t.sub.2 according to a pre-determined ordering relation (page 4, definition 6, item 4).

22. As per claim 12, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a node of the form ite(s.sub.1=t.sub.1,H, ite(s.sub.2=t.s- ub.2,K,L)) into a node of the form ite(s.sub.2=t.sub.2,ite(s.sub.1=t.sub.1- ,H,K),ite(s.sub.1=t.sub.1,H,L)) in response to a determination that s.sub.1=t.sub.1 is greater than s.sub.2=t.sub.2 according to a pre-determined ordering relation (page 4, definition 6, item 5).

23. As per claim 13, Groote discloses a method of claim 1, wherein the plurality of transformation rules includes mapping a first set of nodes that are true children of a node of the form ite(s=t,H,K) into a second set of nodes that is identical to the first set of nodes except that occurrences of s in the first set of nodes are replaced by t in the second set of nodes (page 4, definition 6, item 8).

24. As per claims 14-17 and 19-26, note the rejection of claims 1-4 and 6-13 above. The Instant claims are functionally equivalent to the above-rejected claims and are therefore rejected under same prior-art teachings.

25. As per claim 27-30, note the rejection of claims 1-4 above. The Instant claims are functionally equivalent to the above-rejected claims and are therefore rejected under same prior-art teachings.

Conclusion

26. All claims rejected.

Applicant's amendment necessitated the new ground(s) of rejection presented in this

Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant

is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS

from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the

mailing date of this final action and the advisory action is not mailed until after the end of the

THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the

date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be

calculated from the mailing date of the advisory action. In no event, however, will the statutory

period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner

should be directed to David Silver whose telephone number is (571) 272-8634. The examiner

can normally be reached on Monday thru Friday, 9am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Kamini Shah can be reached on 571-272-2279. The fax phone number for the

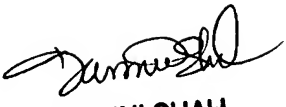organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

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system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David Silver

Examiner
Art Unit 2128

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KAMINI SHAH
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